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Brookhaven Medical Research Reactor

Facility Environmental Monitoring Report

Calendar Year 2004

BROOKHAVEN
NATIONAL LABORATORY

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Summary of Results

Although the BMRR was shut down in December 2000, BNL has maintained the semi-annual emissions monitoring program to verify that radionuclide emissions are diminishing as anticipated. Emissions monitoring during 2004 confirmed that no radionuclides are being emitted from the BMRR facility.

A sample of the BMRR's air conditioning condensate collected on June 17, 2004, had a tritium concentration of 199,000 pCi/L. Normally the tritium concentrations are <40,000 pCi/L. The elevated tritium concentration prohibited continued discharge to sanitary, and BMRR stabilization personnel were instructed to containerize the condensate. Due to the low volume of these releases, there were no observed spikes in tritium concentrations in the STP's influent or effluent. The increase in tritium concentration was attributed to efforts to ready the reactor for D&D, which allowed venting of various reactor components to the ambient workspace. Tritium in the AC condensate was returned to levels below the minimum detection limit through the reconfiguration of the air conditioning system (air intake/re-circulation). The resumption of condensate discharges to sanitary was approved on August 5, 2004.

Tritium continues to be detected in groundwater downgradient of the BMRR, but at concentrations well below the 20,000 pCi/L drinking water standard. During CY 2004 the maximum observed tritium concentration was 2,430 pCi/L.

Background

The Brookhaven Medical Research Reactor (BMRR) is a 3 MW light water reactor that was used for biomedical research. Research operations at the BMRR stopped in December 2000, and BNL is preparing plans to permanently decommission the facility.[1]

Comment [KR1]: We need to say whether the fuel removal occurred in 2002 as scheduled, and if all primary cooling water was drained.

Unlike the High Flux Beam Reactor (HFBR), the BMRR does not have a spent fuel storage canal or pressurized embedded piping systems that contain radioactive liquids. Historically, fuel elements that required storage were either stored within the reactor vessel or were transferred to the HFBR spent fuel canal. The BMRR's primary cooling water system consists of a re-circulation piping system that contained 2,550 gallons of water that contained approximately 5 Ci of tritium (Rooks, 2004). This system was drained in July 2005 (Prwivo, 2005). The primary system's piping is fully exposed within the containment structure and was accessible for routine visual inspections.

[1] Thus far, all fuel has been removed from the BMRR, and the primary cooling water system has been drained.

When the BMRR was operational, excess heat was transferred by means of heat exchangers with once-through (secondary) cooling water that was obtained from former Process Well 105 or the BNL Chilled Water System. This secondary water was discharged to recharge basin HP (SPDES Outfall 004) located 800 feet to the south of the Medical Department complex. These discharges were monitored as part of the State Pollutant Discharge Elimination System (SPDES) program.

To cool the neutron reflector surrounding the core of the BMRR reactor vessel, air from the interior of the containment building was used. When air was drawn through the reflector, it was exposed to a neutron field that caused the argon component of the air to become radioactive. This radioactive form is known as argon-41, which is a chemically inert gas with a half-life of only 1.8 hours. After passing through the reflector, air was routed through a roughing filter and a high efficiency particulate air (HEPA) filter to remove any particulate matter, then finally through a charcoal filter to remove radioiodines produced by the fissioning of fuel. Following filtration, the air was vented to a 150-foot stack adjacent to the reactor containment building. Following shutdown in December 2000, a real-time monitor was used to track potential remnant argon-41 air emissions, while passive filter media were used to collect and quantify radioiodines and particulates.

In 1997, tritium was detected in groundwater monitoring wells installed directly downgradient (within 30 feet) of the BMRR. The maximum observed tritium concentration was 17,100 pCi/L in a groundwater sample collected in November 1999, which is approximately 85% of the 20,000 pCi/L drinking water standard. Small amounts of tritium may have been released to the soils below the BMRR when primary cooling water was periodically drained to a basement floor drain and sump system that did not have secondary containment or leak detection. Although the last discharge of primary cooling water to the floor drain system occurred in 1987, the floor drains continued to be used for secondary (nonradioactive) cooling water until 1997. Infiltration of this water may have promoted the movement of residual tritium from the soils surrounding the floor drain piping system to the groundwater. The floor drains were permanently sealed in 1998.

Environmental Monitoring Program

The environmental monitoring program for the BMRR is described in the BNL Environmental Monitoring Plan (BNL, 2004). The BMRR monitoring results and recommendations are summarized below.

Monitoring Results

Air Monitoring

In January 2003, the fuel elements from the BMRR were shipped to an offsite location, thereby eliminating any potential for radioactive emissions from the facility. Semi-annual

air sampling showed no quantifiable radioactive emissions from the facility. In October 2003, a request was made to the EPA to terminate emission monitoring at the BMRR (DOE, 2003). In response, the EPA requested an additional round of sampling be conducted before making a final determination to eliminate the emissions monitoring program. During 2004, the semiannual monitoring confirmed that there were no radioiodines or Ar-41 present in the emissions. Although there was no environmental pathway for tritium releases, as all the vents from the reactor vessel are sealed, a dose estimate was completed for the evaporative loss of tritium. The dose risk from the tritium was estimated to be 7.42E-08 mrem/year to the MEI. This information was communicated to EPA in a memo dated December 23, 2004 (DOE, 2004). In January 2005, EPA approved the discontinuation of the emissions monitoring program at the BMRR (EPA, 2005).

Groundwater Monitoring

Groundwater samples are collected from four monitoring wells (Figure 1). Monitoring results for 2004 indicate that tritium concentrations continued to be well below the 20,000 pCi/L drinking water standard. Detectable levels of tritium were observed in all three downgradient wells, with a maximum value of 2,430 pCi/L in Well 084-27 (Table 1 and Figure 2). Note: groundwater monitoring conducted from 1997 though 2001 did not detect any other reactor-related radionuclides using gamma spectroscopy, gross alpha/beta, and strontium-90 analyses. Therefore monitoring conducted during 2002-2004 focused on tracking tritium concentrations in the groundwater.

SPDES Monitoring

Water discharges from the BMRR were permanently discontinued in June 2001, and a request to end the discharge-monitoring program for this outfall was approved by NYSDEC in February 2002. Consequently, there were no samples collected from this outfall in 2004.

Discharges to Sanitary

Periodically, small volumes of BMRR air conditioning condensate are discharged to the BNL sanitary system. This water is monitored for tritium to ensure the concentrations remain within BNL's release criteria. Historically, tritium concentrations in the condensate have ranged between non-detectable levels to 40,000 pCi/L. Due to the low volumes released, these discharges have had no impact on the Sewage Treatment Plant influent and effluent tritium concentrations.

A sample of the condensate collected on June 17, 2004, had a tritium concentration of 199,000 pCi/L. The elevated tritium concentration prohibited continued sanitary discharge, and BMRR stabilization project personnel were instructed to containerize all condensate until further notice. There were no observed spikes in tritium concentrations in the STP's influent or effluent. The increase in tritium concentration was attributed to

efforts to ready the reactor for D&D, which allowed venting of various reactor components to the ambient workspace. Tritium in the AC condensate was returned to levels below the minimum detection limit through the reconfiguration of the air conditioning system (air intake/re-circulation). Resumption of condensate discharges to sanitary was approved on August 5, 2004.

Future Monitoring Actions

The following actions will take place during the 2005 monitoring period:

- Because tritium concentrations in groundwater have remained at levels well below the 20,000 pCi/L drinking water standard, the monitoring frequency will be reduced to annually starting in 2005.
- As approved by the US EPA, the air emissions monitoring program will be terminated.
- Continue testing air conditioning condensate for tritium.

References

BNL. 2004. *Brookhaven National Laboratory Environmental Monitoring Plan*. BNL-52676. Brookhaven National Laboratory, Upton, NY. January 2004.

DOE, 2003. Letter from M.D. Holland to J. Eng. *Notification of Discontinuing Emissions Monitoring at the Brookhaven Medical Research Reactor (BMRR)* dated October 10, 2003.

DOE, 2004. Letter from M.D. Holland to J. Eng. *Brookhaven National Laboratory (BNL) Semiannual Sampling and Air Dose Evaluation at the Permanently Shutdown Brookhaven Medical Research Reactor (BMRR)* dated December 23, 2004.

USEPA, 2005. Untitled letter from J. Eng to M.D. Holland, in response to DOE request to discontinue emissions monitoring at the BMRR. Letter dated January 4, 2005.

Prwivo, R.J., 2005. E-mail memorandum *BMRR Vessel Draining* to G. Goode dated July 28, 2005.

Rooks, R. 2004. E-mail memorandum to D. Paquette dated June 4, 2004.

Table 1. CY 2004 Groundwater Tritium Results for BMRR Monitoring Wells.

Well	Location	Collection Date	Tritium Result	Tritium MDL
			----------pCi/L----------	
84-28	Upgradient of BMRR	03-03-04	<330	330
		09-20-04	NS	
84-12	Downgradient of BMRR	03-03-04	330 +/- 220 (J)	320
		09-20-04	<310	310
84-13	Downgradient of BMRR	03-03-04	410 +/- 230 (J)	320
		09-20-04	930 +/- 280	310
84-27	Downgradient of BMRR	03-03-04	1,370 +/- 360	330
		09-20-04	2,430 +/- 430	300
Drinking Water Standard			20,000	

Notes:
MDL = Minimum Detection Limit
"<" preceding a value (e.g., <330) indicates that the measured value was less than the stated MDL.

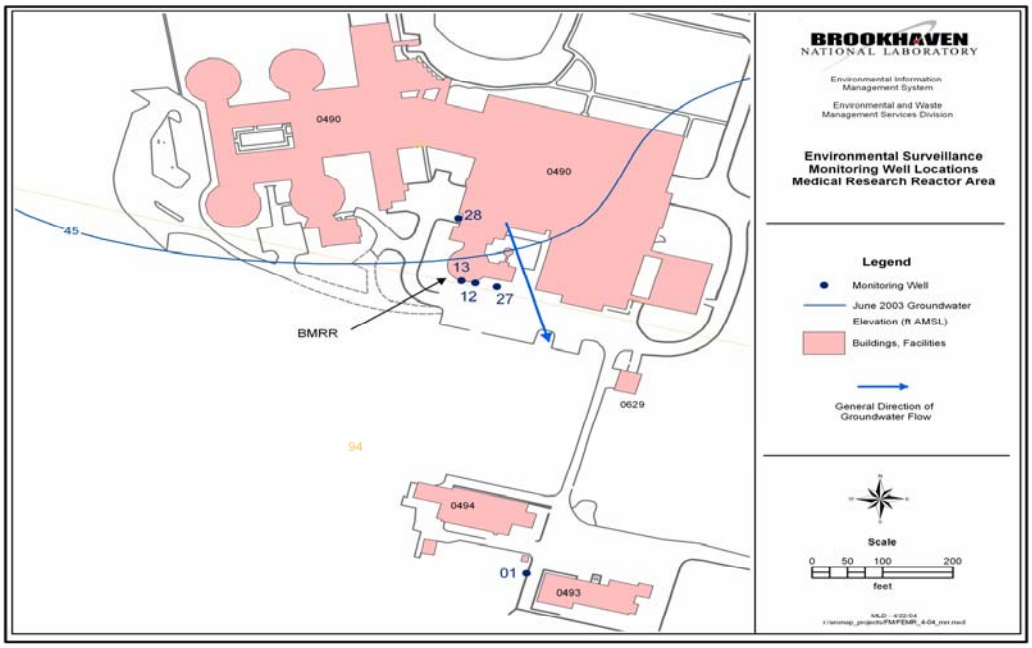

Figure 1. BMRR Area Groundwater Monitoring Wells.

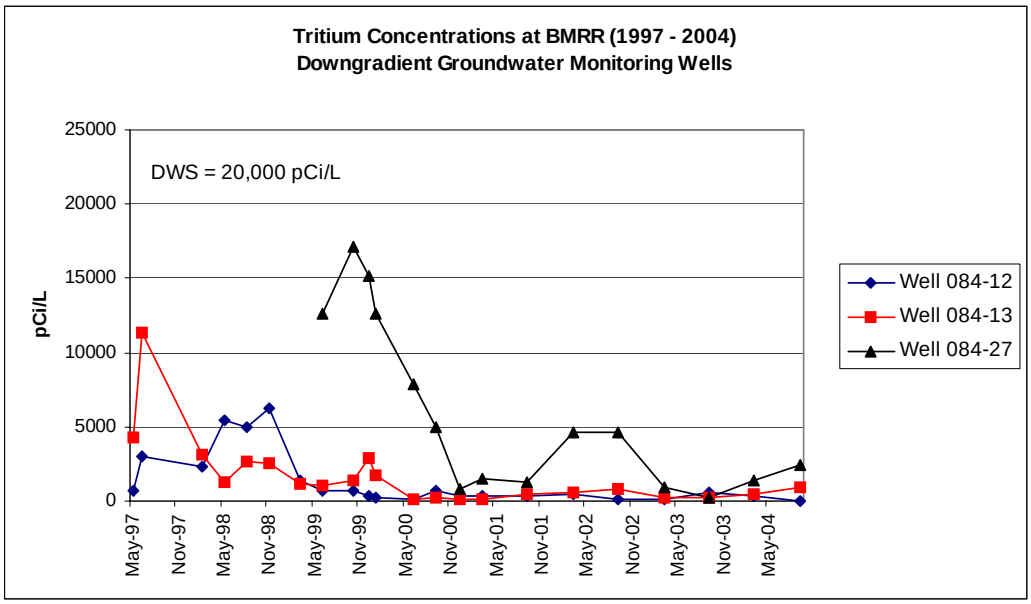

Figure 2. Tritium Concentrations at the BMRR 1997–2004.